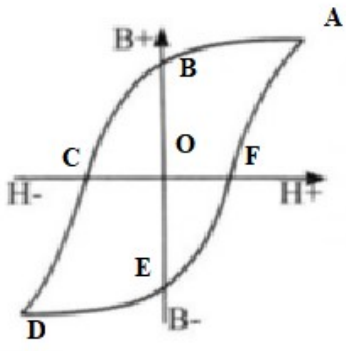
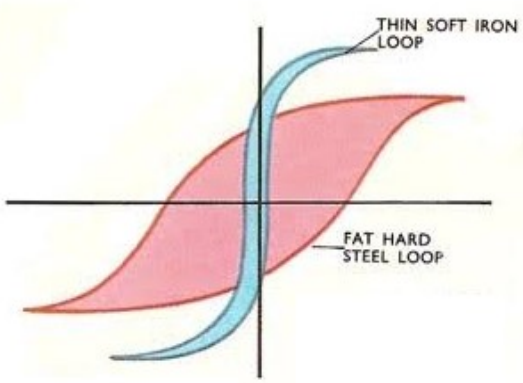
Important suggestions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and communication skills)
4) While assessing figures, examiner may give credit for principle components indicated in a figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case some questions credit may be given by judgment on part of examiner of relevant answer based on candidate understands.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q.1	**Attempt any FIVE of the following :** **10 Marks**
a)	**List the different types of switches.**
Ans	**Types of switches:** **(Any Two types expected: 1 Mark each: Total 2 Marks)** 1. One switch (SPST) 2. Two way switch (SPDT) 3. DP or DPDT 4. TPDT 5. TP 6. Intermediate switch 7. Six terminal marvel switch OR 1. Tumbler switch 2. Piyano type switch 3. Pull switch 4. Push button switch 5. Flush switch 6. Rotary switch.

b)	**Draw the labelled hysteresis loop for hard steel material.**
Ans	**Labelled hysteresis loop for hard steel material:** **(2 Marks)**  **OB = Residual Magnetizm** **OC= Coersive force**  **OR**
c)	**State the causes for dielectric failure of highly purified transformer oil.**
Ans	**The causes for dielectric failure of highly purified transformer oil:** **(Any Two causes expected: 1 Mark each: Total 2 Marks)** 1. Voltage rating 2. Humidity in atmosphere 3. Temperature of the oil 4. Due to improper cable joints and connection. 5. Increasing in supply frequency. 6. Due to unbalanced load.
d)	**List any four applications of insulting material used in electrical fields.**
Ans	**Applications of insulting material used in electrical fields:** **(Any Four applications expected: 1 Mark each: Total 2 Marks)** 1. In Electrical machines 2. In electrical transformers. 3. Transformer bushing 4. Insulators 5. Domestic equipment's (or any other equivalent applications) 6. Insulation on wires and cables

e)	**Enlist four harmful effects of improper earthing.**
Ans	**Following Harmful effects of improper earthing:** **(Any Two effects expected: 1 Mark each: Total 2 Marks)** 1. Fire Hazards 2. Ground fault 3. Risk of electrical shock to the operator 4. Chances of lighting strokes is more. 5. Malfunctioning of relay and circuit breakers.
f)	**State any two applications of gaseous insulating material used in switchgears.**
Ans	**Applications of gaseous insulating material used in switchgears:** **(Any Two applications expected: 1 Mark each: Total 2 Marks)** 1. Non inflammable material (gas) in switchgear. 2. High dielectrical strength material in electrical machine. 3. As a cooling agent in circuit breaker
g)	**State any two applications of: (i) Ferromagnetic (ii) Paramagnetic material.**
Ans	**Applications of Ferromagnetic Materials:** **(Any Two applications expected: 1 Mark each: Total 2 Marks)** 1. In the transformer laminations. 2. In Electrical machines as a magnetic material. 3. In Magnetic poles of motor and generator 4. Magnetic recording device **Applications of Paramagnetic material:** **(Any Two applications expected: 1 Mark each: Total 2 Marks)** 1. Solid state MASER 2. Using adiabatic demagnetization low temperature can be achieved.
Q.2	**Attempt any THREE of the following : 12 Marks**
a)	**State the causes of deterioration of liquid and solid dielectrics.**
Ans:	**The causes of deterioration of liquid and solid dielectrics:** **(Any four causes are expected: 1 Mark each: Total 4 Marks)** 1. Voltage rating 2. Humidity in atmosphere or moisture content.

	3. Temperature of the oil and solid dielectric material 4. Due to improper cable joints and connection. 5. Increasing in supply frequency. 6. Due to unbalanced load.
b)	**Explain the function of ELCB and ICDP switch. List two specifications of each.**
Ans:	**i) Function of ELCB- (Earth Leakage Circuit Breaker)** **(1 Mark)** An Earth Leakage Circuit Breaker (ELCB) is a device used to directly detect currents leaking to earth from an installation and cut the power and avoid the person from getting shock. **OR** At the time of earth fault cut the power supply **The standard specifications of ELCB available in the market:** **(1 Mark)** 1. There are three categories as per the sensitivity :' B' class ELCB for residential, 'C' Class ELCB for commercial and 'D' class ELCB for industrial. 2. The ELCB are available in 30 mA,100 mA, 300 mA, 500 mA and 1000 mA 3. The low sensitivity ELCB are used for electrical machine the rating is in between the 3A to 10 A **ii) ICDP :** **(1 Mark)** ICDP means Iron clad Double pole. Its function is for cut off operation of single phase supply. **The standard specifications of ICDP available in the market:** **(1 Mark)** 1. The ICDP are available in single phase, 16A, 32A, 240 volts
c)	**Name any two applications of following gases: (i) Nitrogen (ii) Hydrogen (iii) Sf6 (iv) Air.**
Ans:	**i) Applications of Nitrogen:** **(1 Mark)** 1. As a cooling agent. 2. To avoid oxidation. 3. Electrical insulating material (Gas) in electrical equipment. **ii) Applications of Hydrogen:** **(1 Mark)** 1. High thermal conductivity material (gas). 2. High electrical strength material. 3. As a cooling agent in electrical machines.

iii) Applications of SF_6 (Sulpher Hexa fluoride) : **(1 Mark)**

1. Non inflammable material (gas).
2. High dielectrical strength material.
3. As a cooling agent in circuit breaker.

iv) Applications of Air: **(1 Mark)**

1. As a cooling agent in electrical machines.
2. Electrical insulating material (Gas) in electrical equipment.

d) Explain the suitability of copper as an electrical conductor with reference to its mechanical and electrical properties.

Ans: **Following are properties of conductor:-**

(Any Four expected : 1 Mark each: Total : 4 Marks)

i) High conductivity :-

Material should have high conductivity, So that

- Cross section of conductor (size) reduces,
- Copper losses reduces,
- So Efficiency increases,
- Voltage drop reduces,
- So, Regulation gets improved.

ii) High mechanical strength:-

Material should have sufficiently high mechanical strength to with stand against

- Rough handling of conductor during transportation & Stringing,
- Wind Pressure,
- Ice loading and
- Severe climatic condition

iii) **Flexibility:-**

Material should be flexible for

- Easy handling and
- Storage

iv) **Weight:-**

Material should be light in weight to reduce transportation & handling cost.

v) **High resistance to corrosion:-**

Material should have high resistance to corrosion

- To avoid rusting

vi) **Brittleness:-**

Material should not be brittle.

- So that it will not easily cut after twisting.

vii) **Temperature coefficient of resistance:-**

Material should have low temperature coefficient of resistance.

viii) **Availability & cost:-**

Material should be easily available & less costly.

ix) **Scrap Value:-**

Material should have high scrap value.

OR

Properties of Copper: **(Any Four expected : 1 Mark each: Total : 4 Marks)**

1. **Conductivity :** High (1.6 times more than Aluminum)
2. **Resistivity :** $\rho = 1.68 \times 10^{-8}$ ohm m / 0.01786 ohm m /mm^2 at 20^0 C
3. **Mechanical Strength:** High, Tensile strength = 40 kg/mm^2
4. **Weight:** High, specific gravity = 8900 kg/mm^2
5. **Flexibility :** Less flexibility
6. **Temperature coefficient of resistance :** $\alpha = 0.0038/^0$C at 20^0 C
7. **Soldering & Welding :** It can be welded & solder easily
8. **Melting point :** 1083 ^{0}C
9. **Thermal conductivity :** Thermal conductivity of copper is about twice
10. **Young modulus :** 13000 kg/mm^2

Q.3 **Attempt any THREE of the following :** **12 Marks**

a) **State the use of following: (i) Screw driver (ii) Nose pliers (iii) Wire gauge (iv) Test lamp**

Ans: **(Use of each tools : 1 Mark each)**

i) Screw Driver: Usually hand-operated, for turning screws with slotted heads for losing and tightening the screws.

ii) Nose pliers : To hold and tight the wires

iii) Wire Gauge: To measuring the thickness of a cable and wire. (or diameter)

iv) Test lamps: To check the supply voltage, Verification of voltage & current in the system and also check the open circuit fault.

b) **Enlist types of electrical wiring systems. Explain casing and capping type wiring system.**

Ans: **(Any four types are expected: 1/2 Mark each, 2 Marks)**

List the types of Internal wiring in residential installations –

1) Cleat wiring
2) Batten wiring
3) Wooden casing capping wiring
4) PVC conduit wiring
5) PVC casing capping wiring
6) Concealed wiring

Explanation : **(2 Marks)**

1) Casing Capping type wiring system:

The cost of wiring is slightly more. The PVC or VIR wires are carried through PVC casing capping. This wiring is very simple so it is widely used. More number of wires can be carried through the different size of PVC casing capping. Wires are not exposed to the sky, so there are less chances of mechanical injury. Future expansion is possible and repairing and maintenance is easily possible.

c) **Compare copper and alluminium on the basis of : (i) Tensile strength (ii) Conductivity (iii) Specific gravity (iv) Application**

Ans: **(Each point: 1 Mark. Total 4 Marks)**

S.No	Points	Copper	Alluminium
i)	Tensile strength	High, twice that of	Less, half that of copper.

		aluminum. Tensile strength = 40 kg/mm^2	Tensile strength = 18 kg/mm^2
iii)	Conductivity	High (1.6 times more than Aluminum)	Less than copper (1.6 times lesser than copper)
iii)	Specific gravity	High (8.9)	Less (2.7)
iv)	Application	As a cable conductor, winding wire, bus bar, contacts, wire as a conductor (because of its cost it isn't used as a overhead conductor)	It is widely used as a conductor for transmission & distribution line as well as a cable conductor, winding wire, bus bar, contacts, and wire as a conductor.

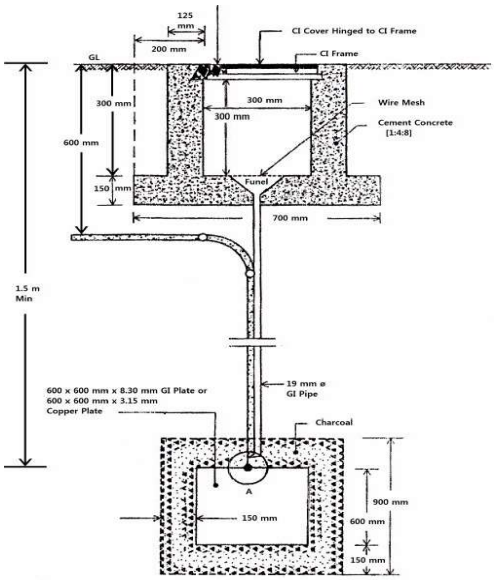
d) Describe with neat sketch any one type of earthing system.

Ans: Types of Earthing System:

1. Plate earthing
2. Pipe Earthing
3. Strip or wire earthing
4. Rod earthing

i) Plate earthing :

(Any One Type of earthing Diagram & explanation are expected, Diagram: 2 Marks & Explanation : 2 marks, Total : 4 Marks)

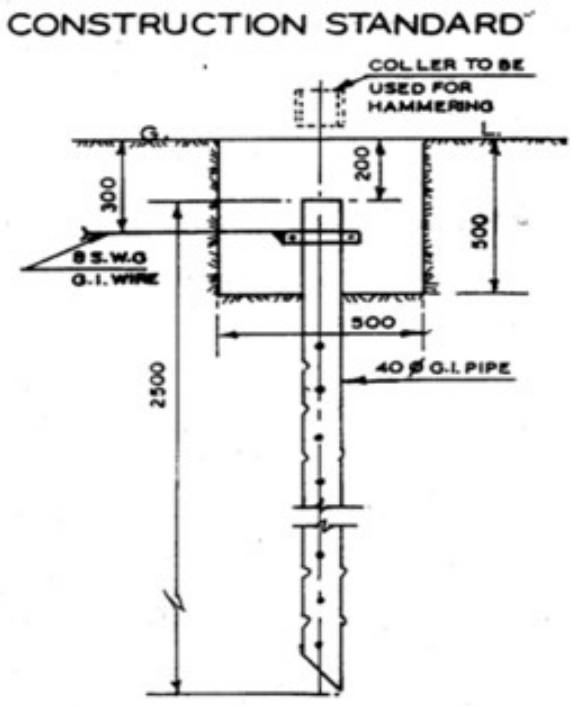


or equivalent figure

Explanation:

- The earthing is installed as per above figure.
- The size of earthing plate is 60cm x 60cm x 3.18 mm copper.
- The earth wire having the size of 8 gauge copper, the earthing plate is surrounded by the alternate layer of charcoal and salt.
- To minimize the earth resistance the earthing maintenance is required, to maintain this earth resistance the pouring of salt water in the wire mesh by removing the cover on wire mesh for every month.
- The Plate type earthing is generally carried out muddy area where percentage of loose earth soil is more

ii) Pipe Type earthing:



or equivalent figure

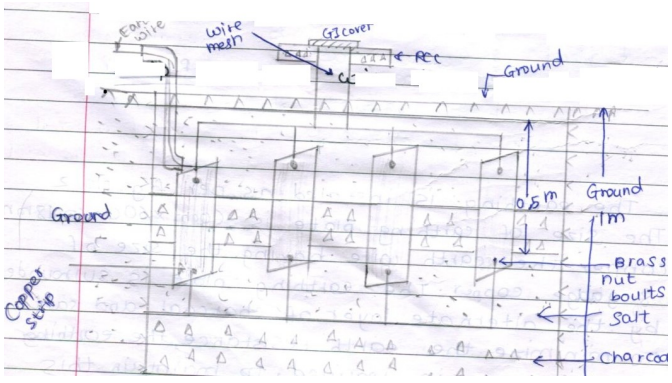
- This earthing is generally carried out in locky area where digging is not possible.
- In that case by boaring the suitable diameter of hole in locky area at the depth of 3.75m.
- The earthing GI pipe having the diameter of 38 mm are embedded in the ground with alternate layers of charcoal and salt.

- 8 Gauge copper wire is also taken outside in addition with 10 mm diameter GI pipe.
- The wire mesh is necessary by pouring the salt in the earthing pit.

OR

- Excavation on earth for a normal earth Pit size is 2.7 M X 0.6 M X 3.0 M.Or 4.5 M
- For Pipe type earthing normal practice is to use; GI pipe [C-class] of 75 mm diameter of length Having 6 numbers of holes for the connection of earth wires
- Normal Practice is to use GI earthing pipe of length.
- Cover Top of GI pipe with a T joint to avoid jamming of pipe with dust & mud and also use water time to time through this pipe to bottom of earth plate when required.
- These types of earth pit are generally filled with alternate layer of charcoal & salt up to 4 feet from the bottom of the pit.
- Make a mixture of Coal Powder, Salt & Sand all in equal part.
- Use of Coal Powder also beneficial as it is anti-corrosive.
- The electrical installation which to be earthed, is connected to the top of the earth rod by means of copper or aluminium earth continuity conductor of sufficient cross-section.

iii) Strip type or wire type earthing:



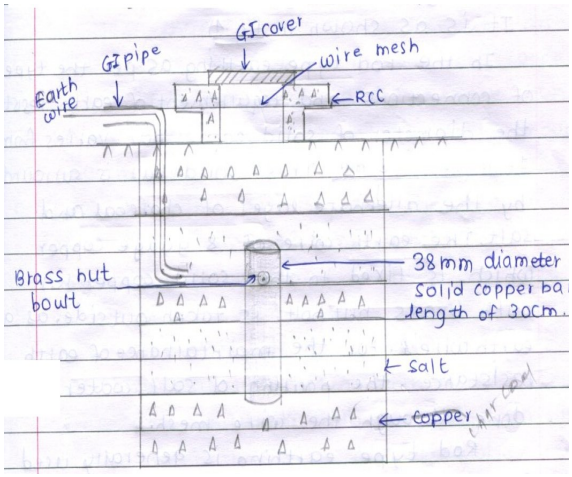
or equivalent figure

- In this type or earthing the copper strip which are more than one, are connected in parallel with each other and separated at least 30 cm from each other.
- The copper strip which are connected in parallel are surrounded by the alternate layers of charcoal and salt.
- The 8 gauge copper wire, which is connected to the brass nutbolt to the earthing strip is taken outside as a earth wire.
- For the maintenance of earth resistance, the pouring of salt water is done by through the

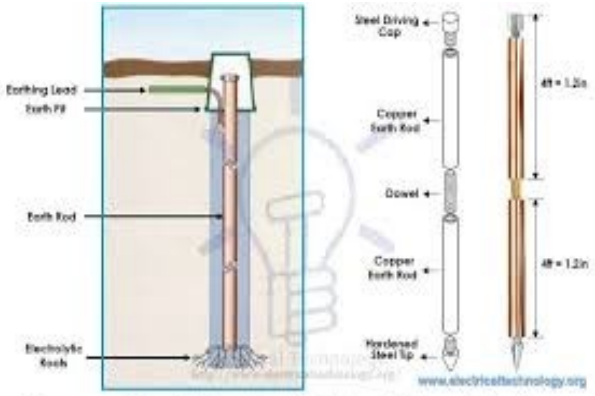
wire mesh.

- The strip type earthing is generally done in rocky area soil condition.

iv) Rod type earthing:



OR



Copper Rod Electrode Earthing System

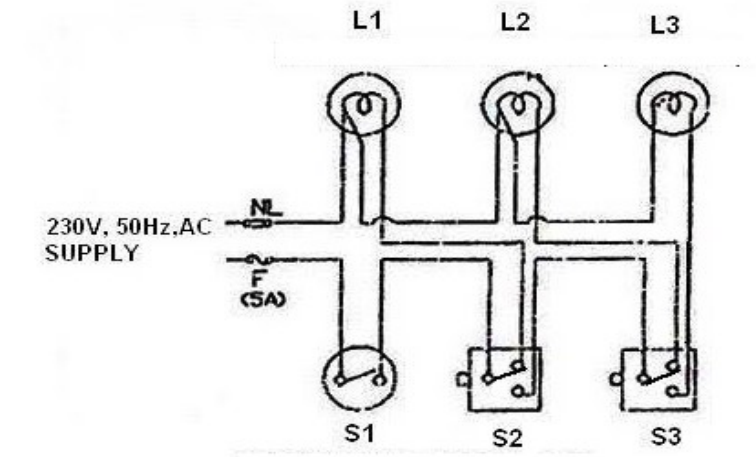
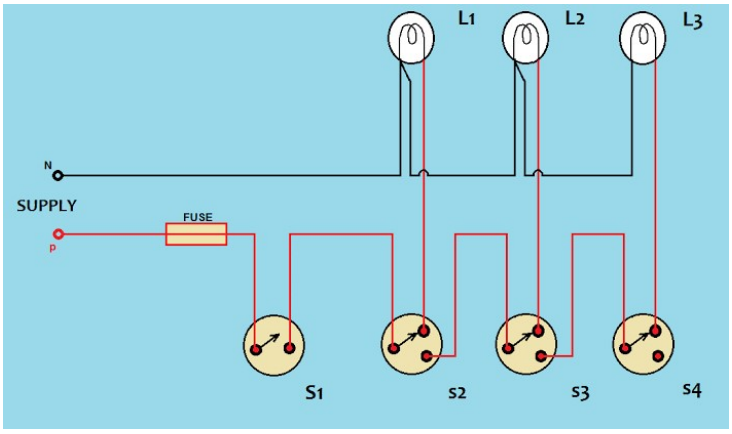
- This is cheapest and easiest method of earthing as this method does not require any excavation work.
- In this type of earthing, a metallic rod of sufficient length is driven vertically into the ground normally by hammering on the top.
- The driven rods be a minimum of 8- 10 feet in length and length of rod must be in direct contact with the soil.
- The electrical installation which to be earthed, is connected to the top of the earth rod by means of copper or aluminium earth continuity conductor of sufficient cross-section.
- Rod type earthing is generally used for muddy area or rocky area for immediate earthing purpose.

Q.4	**Attempt any THREE of the following :**	**12 Marks**
a)	**State any four IE Rules to be followed in respect of safety while working on electrical installation system.**	

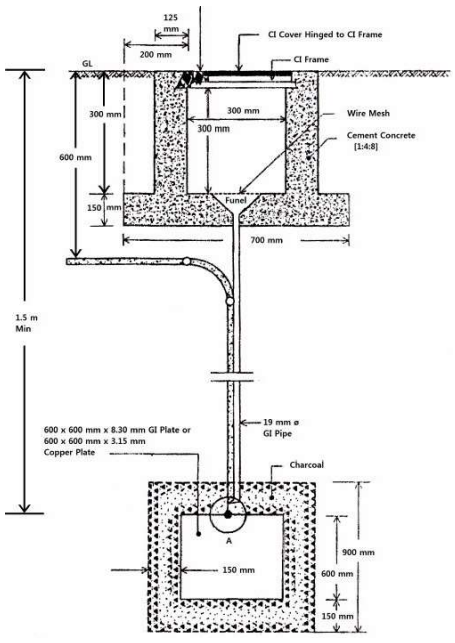
Ans: **While working in an electrical installation following safety IE rules regarding with safety:** **(Any Four point are expected : 1 Mark each: Total : 4 Marks)**

1. IE Rule 3 : Authorization
2. IE Rule 29 : Construction and maintenance of electrical supply line and apparatus
3. IE Rule 30: Service line and apparatus on consumers premises.
4. IE Rule 31: IE Rule 30: Cut out on consumer premises.

	5. IE Rule 32: Identification of earthed and earthed neutral conductor and position of switches and cut outs therein 6. IE Rule 33: Earthed termination consumers premises. 7. IE Rule 34: Accessibility of bare conductors 8. IE Rule 35: Danger boards notices 9. IE Rule 36: Handling of electrical supply line and apparatus. 10. IE Rule 37: Supply to vehicles, cranes etc. 11. IE Rule 38: Cable for portable or transportable apparatus. 12. IE Rule 41: Distinction of different circuits. 13. IE Rule 41A: Distinction of the installations having more than one feed 14. IE Rule 42: Accidental charges 15. IE Rule 43: Provision applicable to protective equipment's. 16. IE Rule 44: Instruction for restoration of persons suffering from electrical shock. 17. IE Rule 44A: Intimation of accidents 18. IE Rule 45: Precautions to be adopted by consumers, owners, occupiers, electrical contractors, electrical workman and suppliers. 19. IE Rule 46: Periodical inspection and testing of consumers installation. 20. IE Rule 48: Precaution against leakage before connection. 21. IE Rule 49: Leakage on consumers premises 22. IE Rule 50: Supply and use of energy. 23. IE Rule 54: Declared voltage of supply to consumers 24. IE Rule 55: Declared frequency of supply to consumer 25. IE Rule 56: Sealing of meters and cutouts 26. IE Rule 60: Test for resistance of insulation 27. IE Rule 61: Connection with earth
b)	**Classify magnetic materials with two examples each.**
Ans:	**Classification of magnetic materials : (Any Two Classification of Magnetic materials are expected: 2 Mark each, Total 4 Marks)** 1. Ferromagnetic materials : e.g. a) Iron b) Nickel c) Cobalt 2. Paramagnetic Material : e.g. a) Aluminium b) Platinum c) oxygen 3. Diamagnetic Material: e.g. a) Germanium b) Gold c) Silver d) Copper

c)	**Draw neat diagram for Godown wiring.**
Ans:	**Diagram for Godown wiring:** **(4 Marks)**  **OR**  **or equivalent figure**
d)	**Define "Magneto-striction"? State the causes for loss of magnetism.**
Ans:	**Magneto-striction:** **(2 Mark)** Magneto-striction is the change in dimensions of ferromagnetic material, when it is magnetized **Following are the causes for loss of magnetism:** **(2 Mark)** 1. **Heating effect:** Beyond a certain temperature i.e. curie temperature it destroys the polarization of the material i.e loss of magnetization 2. **Sharp impact:** Due to any impact on magnetic material changes its magnetization properties. 3. **Due to Stray magnetic field**: it cancels the magnetic domains and the magnetism will be weak. 4. **Due to mechanical Process**: Due to punching, cutting, drilling and machining loss of magnetism is possible. 5. **Due to Ageing**: Loss of Magnetism is possible.

d)	**Give one application of :(i) Mineral oil (ii) Varnish (iii) Synthetic oil (iv) Vegetable oil**
Ans:	**i) Application of Mineral oil:** **(1 Marks)** 1. Used in transformer. 2. Used in switchgear 3. Used for circuit breaker 4. Used for capacitor 5. Used in paper insulated cables 6. It is used in Rector **ii) Application of Varnish:** **(1 Marks)** 1. Used as impregnating varnish in windings 2. Used as coating varnish on different material. 3. Used as epoxy resin varnish **iii) Application of Synthetic oil:** **(1 Marks)** 1. Used in capacitors 2. Used in precise high cost switchgear **iv) Application of Vegetable oil:** **(1 Marks)** 1. Used as a lubricant. 2. For illumination effect 3. Used for eating purpose.
Q.5	**Attempt any TWO of the following :** **12 Marks**
(a)	**Explain the function of : (i) DB (ii) Socket (iii) Cable (iv) Switch**
Ans:	**i) Function of DB: (Distribution Board or Box) :** **(2 Marks)** ➢ To distribute the load and provide the sub circuits in lighting load and power load. **ii) Function of Socket:** **(2 Marks)** ➢ Availability of supply for connecting portable equipments. **iii) Function of Cable:** **(1 Marks)** ➢ To provide electrical supply to the equipment or load to carry the current. **iv) Function of Switch:** **(1 Marks)** ➢ To make the supply ON and OFF.

b)	**Explain following wiring systems: (i) Concealed wiring (ii) Metal conduit wiring**
Ans:	**i) Concealed wiring:** **(3 Marks)** The cost of wiring is very high. The PVC or VIR wires are carried through the channels made in ceilings and walls at the time of building construction. This wiring is slightly difficult but appearance is very good, so it is widely used. More number of wires can be carried through the different size of channels. Wires are not exposed to the sky, so there are less chances of mechanical injury. Fault finding is difficult. Future expansion is not possible and repairing and maintenance difficult. **2) Metal Conduit wiring:** **(3 Marks)** The cost of wiring is high. The PVC or VIR wires are carried through metal conduit. This wiring is very simple. More number of wires can be carried through the different size of metal conduit. Wires are not exposed to the sky, so there are less chances of mechanical injury. future expansion is not easily possible. Generally metal conduit wiring is preferred in industries or workshops but if there is any earth fault then the leakage current may pass through the conduit and hence now a days it is rarely used.
c)	**Describe with neat sketch the installation of plate earthing.**
Ans:	**Diagram of Plate earthing : (Diagram: 3 Marks & Explanation: 3 Marks, Total 6 Marks)**  **or equivalent figure**

Explanation:

- The earthing is installed as per above figure.
- The size of earthing plate is 60cm x 60cm x 3.18 mm copper.
- The earth wire having the size of 8 gauge copper, the earthing plate is surrounded by the alternate layer of charcoal and salt.
- To minimize the earth resistance the earthing maintenance is required, to maintain this earth resistance the pouring of salt water in the wire mesh by removing the cover on wire mesh for every month.
- The Plate type earthing is generally carried out muddy area where percentage of loose earth soil is more

Q.6 Attempt any TWO of the following : 12 Marks

a) State any two electrical, mechanical and thermal properties of insulating materials.

Ans:

i) Electrical Properties of insulating material:-

(Any Two properties expected : 1 Mark each)

1. It should have high resistance.
2. It should have high breakdown voltage.
3. It should have high dielectric strength.
4. It should have low dielectric loss.
5. It should have high dielectric constant.

ii) Mechanical Properties of insulating material:-

(Any Two properties expected : 1 Mark each)

1. It should have high mechanical strength.
2. It should be tough and flexible.
3. It should be light in weight.
4. It should not be porous otherwise it increases moisture holding capacity which reduces insulating property.

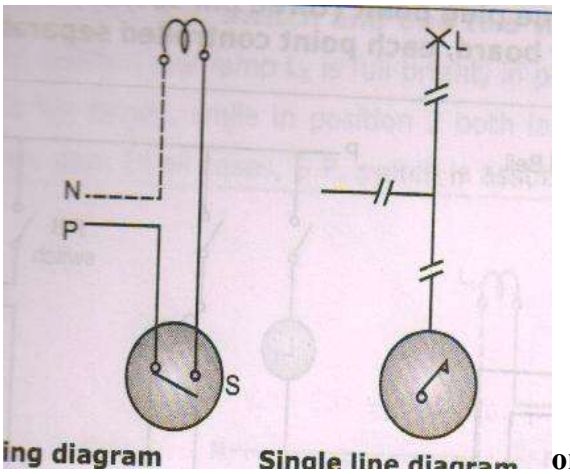
iii) Thermal Properties of insulating material:-

(Any Two properties expected : 1 Mark each)

1. It should have high thermal conductivity.
2. It should be non -inflammable.
3. It should withstand at high temperature.
4. Ii should have thermal Stability.
5. Co-efficient of thermal expansion should be low.

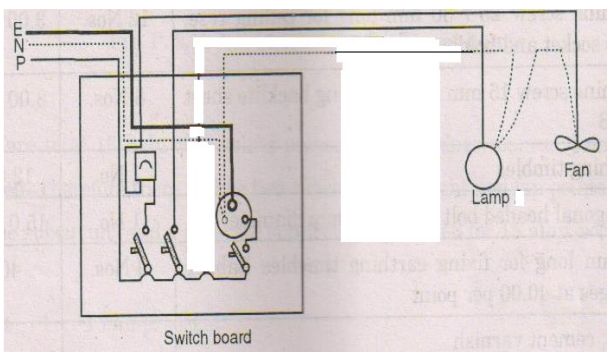
b) **Draw neat circuit diagram for below mentioned requirements in electrical circuit. (i) One lamp controlled by one switch. (ii) One lamp, one fan, one two pin socket controlled by separate switches.**

Ans: **i) Circuit diagram for one lamp controlled with one switch:** **(3 Marks)**

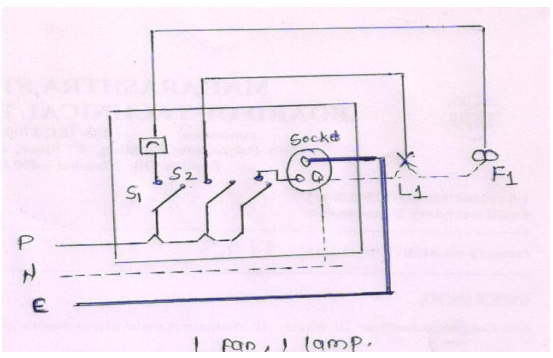


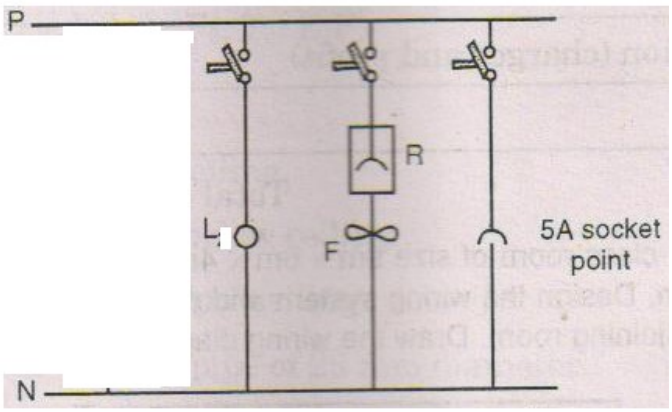
or equivalent figure

(ii) One lamp, one fan, one two pin socket controlled by separate switches : **(3 Marks)**



OR



	or equivalent fig  **or equivalent figure**
c)	**Explain the importance of proper earthing system. Recommend and justify the earthing system used for individual bunglow.**
Ans:	**The importance of proper earthing system:** **(3 Marks)** ➢ To save human life from danger of electrical shock or death i.e. To provide an alternative path for the leakage current to flow so that it will not danger to the user. ➢ To protect high rise buildings structure against lightening stroke. ➢ To ensure that all exposed conductive parts do not reach a dangerous potential. ➢ To provide safe path to dissipate lightning and short circuit currents. ➢ To provide stable platform for operation of sensitive electronic equipment's. **Recommend the earthing system used for individual bunglow:** **(2 Marks)** ➢ Depend upon location of bunglow and total electrical load of bunglow ➢ For muddy area zone bunglow use Plate type earthing ➢ For rocky area zone bunglow use Pipe type earthing **Justify the earthing system used for individual bunglow:** **(1 Marks)** ➢ Material and labour cost should be minimum in above case ➢ Earthing resistance is maintained below 5 ohm to 8 ohm. ➢ for plate earthing maintenance required is less & more convenient

---------- END----------